Letter of Interest for Research at Homestake February, 2006

Title: Limits of Life in the Biosphere

Investigator: Tom Kieft (tentative), New Mexico Tech

Collabotrators: TNTC

Science Goals: The goal of this multidisciplinary project is to quantify limits of life; with regards to depth, pressure, temperature, carbon or energy. Sampling of deep ancient waters, perhaps even waters that have been separated from the surface for a billion years would provide novel insights into constraints and limits of life on Earth and likely other planets. Identification of diminishing sources of carbon and energy would represent a new understanding of deep subsurface biogeochemistry as well as illucidating the importance of abiogenic energy sources independent of the terrestrial surface (e.g., abiogenic hydraogen accumulation).

Research objectives: The objectives will be to assess constraints on life as we understand it. Quantifying impacts of each variable on cell growth, metabolism, and replication and assessing variables independently or in combinations to understand limits imposed by temperature, pressure, depth, energy, carbon or combinations thereof.

Methods: Drilling and coring 1-3 km from the deepest lab may be required to reach the target zone. Intermediate screen zones will be puckered-off enabling repeated sampling over time of multiple discrete fractures and screen zones. Zones within the northern drift and other locastions that accessed anaerobic, hot, and saline water would be be of considerabelk interest. Rigorous Tracer and QA/AC regimes would be required and integrated into our proposed research .

Integration with E&O: This proposed project would be uniquely well suited for multidisciplinary training of 21st century scientists and would inspire students of many disciplines to pursue the quest for the limits of life from chemical, physical, molecular, geological, biochemical, and biological sciences. Ideal for down-hole and surface studies of students and faculty.

Infrastructure Requirements and Impact on Other Users: Lower deep lab infrastructure is required but the impact on others would be slight as it would begin at the onset of deeper lab activities and be well established long before deep physics studies were initiated. After initiation of deep physics experiments drilling activities would be coordinated to occur during ‘down’ times such that co-utilization would be preplanned and readily implemented with considerable sharing of deep infrastructural facilities.

Readiness for Deployment of the Technology: The technology is well developed and teams of investigators and collaborators. Well experienced teams are available. Funding and site preparation are lacking and will likely be unavailable until well after 2012.

Readiness of Effort and Funding: Likely not worthy of consideration until well after 2012.

Budget: $500k/yr for at least 4 years and can only begin after a deep lab is available.
$2my/yr for at least 4 years for coring and installation of 3 km deep boreholes.

ES&H Issues: Requires a deep lab, pumped fluids from the flodded zones, extensive deep infrastructure and safety needs to be in place with extensive rigorous and redundant safety and education.